

latter being found, and it is to be hoped that an accurate survey may eventually be made. The scientific study of the ruins is still in its infancy, and a vast amount of work remains to be done. As has been said, there are two distinct and antagonistic theories of their origin. It is eminently to be desired that the Rhodesian authorities will in every way encourage, nay, promote, further detailed excavations by trained men of science. Such a work would redound greatly to the credit of Rhodesia, and would be followed with the greatest interest throughout the scientific world. It would imply the exploitation of

It has been urged that the ruins have been shorn by Dr. MacIver of their romance. Taking the term romance in its strict sense, this may be true. For legendary uncertainty he has sought to substitute scientific fact. For ill-defined Semitic invaders he offers a native indigenous people; and King Solomon and the Queen of Sheba he replaces with the Monomotapa. How far he is justified will be shown by future investigations. At least he has presented his case in a straightforward and lucid manner in a very attractive and well-illustrated book, and it does not appear that the problem is in any way less fascinating

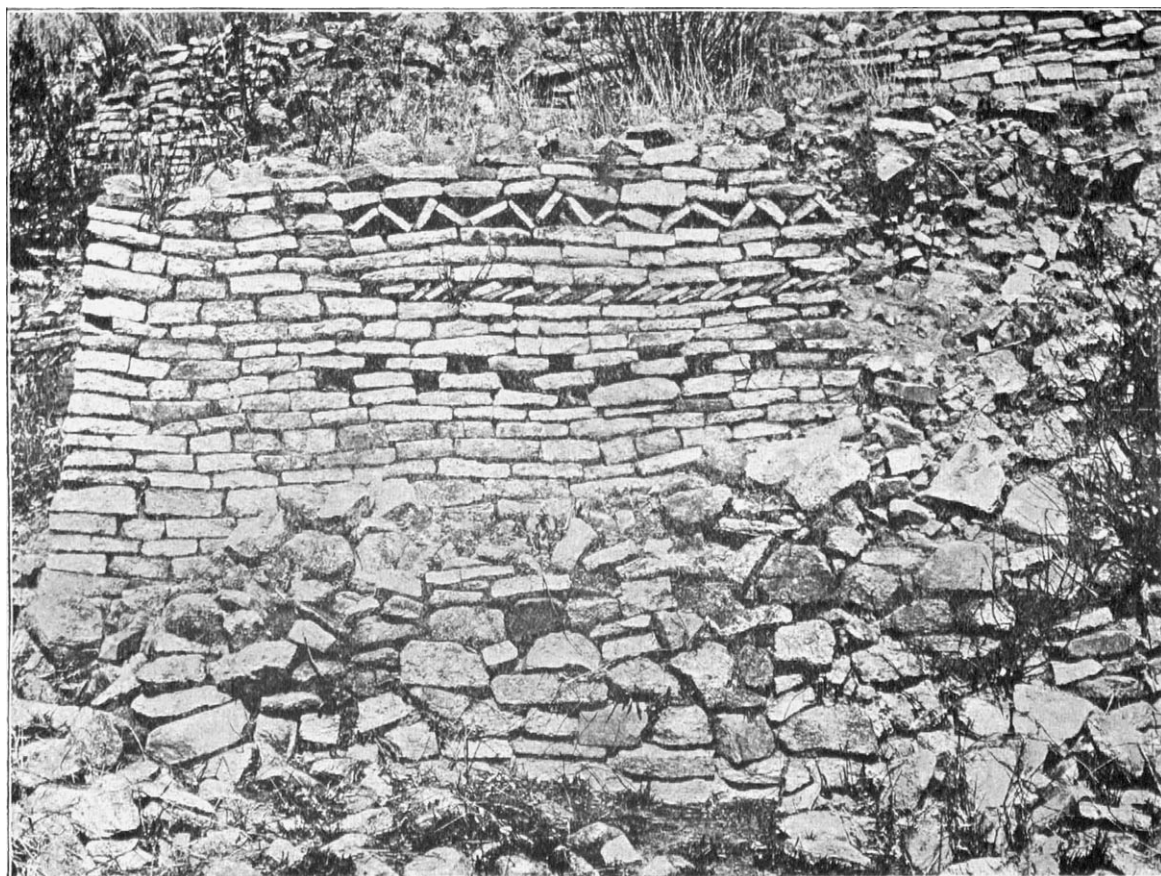


FIG. 2.—Decoration of West Side of Main Entrance, Dhlo-Dhlo. From "Mediaeval Rhodesia."

one of the most valuable scientific assets of the country. Dr. MacIver makes out a strong case, but it is desirable to know more precisely to what group of Bantu peoples the buildings are assignable. Whence came they? Many of the native objects found are identical with those in use by the modern Kafir peoples; others, on the other hand, show affinities with a north-western culture, and appear almost out of place where found. Then again, the older gold mines themselves have hardly been examined at all in detail. They should yield material of importance. It is further desirable to explain more fully the individuality of the different settlements and of the arts of their former inhabitants, to diagnose, for instance, the presence of very numerous stone carvings at the Umtali ruin, excavated by Captain E. M. Andrews, in the light of their prevailing absence elsewhere.

or less worthy of accurate study for having, perhaps, been transferred from the province of archæology to that of ethnology.

PROF. D. I. MENDELÉEFF.

DEATH has been very busy of late among the army of men of science, and nowhere has he been more active than in Russia, where within the space of a few weeks three of that country's foremost chemical philosophers—Beilstein, Mendeléeff, and Menshutkin—all men of front rank and of a world-wide reputation, have submitted themselves to the strict arrest of the fell sergeant. An occurrence of like character and extent is almost unknown in the annals of science. The nearest approach to it is in our own history, when within an interval hardly greater we lost Wollaston, Young, and Davy.

To Beilstein's life and services to chemical science we have already made reference; of Menshutkin, whose death has only just been announced, we hope to speak later. Our immediate concern is with the most distinguished of the eminent triumvirate—Dmitri Ivanovitch Mendeléeff. The chief facts of Mendeléeff's personal history have been given in No. xxvi. of the series of "Scientific Worthies," which appeared in these columns so far back as 1889. It is sufficient here to recall that he was a Siberian, born at Tobolsk on February 7th (N.S.), 1834. He died, therefore, within a week of his seventy-third birthday. He was the seventeenth and youngest child of Ivan Paolowitch Mendeléeff, Director of the Gymnasium at Tobolsk, who, shortly after the birth of his son Dmitri, became blind and lost his position. The family thereby became practically dependent upon the mother, Maria Dmitrievna Mendeleeva, a woman of great energy and force of character, who established a glass works in the town, on the profits of which she brought up and educated her large family. The story of Mendeléeff's youth and early struggles is given in the preface to his great work "On Solutions," which he dedicated to his mother's memory in a passage of singular beauty and power. At the age of sixteen he was sent to St. Petersburg, but, owing to official restrictions, he was prevented from studying chemistry under Zinin at the University, as he had intended, and was transferred to the Pedagogical Institute, where he came under the influence of Woskresensky in chemistry, and of Lenz in physics. Whilst at the institute he wrote his first paper on "Isomorphism," and after serving in the Gymnasium at Simferopol and at Odessa, he gained his *Magister Chemiae* in 1856, and was made a *privat-docent* in the University of St. Petersburg.

At about this period he was attracted to the special line of inquiry and of speculation which was the dominant and most striking feature of his scientific activity, and which eventually culminated in the great generalisation with which his name is inseparably connected. It is easy to detect in these early attempts at tracing the relations between the physical and chemical properties of substances and their molecular and atomic weights the germs of the conception which eventually took shape as the Periodic Law. His work on specific volumes was begun in 1855, and was continued by him in Heidelberg, where he went in 1859, and where he remained until 1861. Germany would appear to have exercised no permanent influence on Mendeléeff. He worked alone, and seems to have derived nothing from personal contact with Bunsen and Kopp. It is significant of his perspicacity that he should at this time have clearly appreciated and publicly declared his belief in the value of Gerhardt's work on the determination of the chemical molecule—at the very period, in fact, when the whole weight of German authority was directed against the doctrine of the new French school. Returning to St. Petersburg, he became professor of chemistry at the Technological Institute. In 1866 he was transferred to the University, and in 1890 he was appointed head of the Standards Department.

Mendeléeff signalled his connection with the University by the publication of his "Principles of Chemistry," which has passed through many editions in Russia, and has been translated into German and English. It is not easy to avoid speaking of this work in terms which savour of hyperbole. Most treatises on chemistry owe a great deal to their predecessors. Indeed, there is probably no form of literature which so obviously proceeds on strictly evolutionary principles. But Mendeléeff's great work is a thing apart—something *sui generis*. The bare facts of chemistry, in greater or less detail, are com-

mon to all such works, but most of them, we fear, would be classed by Lamb among the books which are no books. It is not so with Mendeléeff's "Principles." In its insight, in its grasp of detail and of principle, in its extraordinary power of coordination, in its suggestiveness, and in its wealth of speculation, it is a book among books, and may be read with profit and a pleasure occasionally tinged with amusement by every true student, no matter how old. To those who had the good fortune to know its author personally it reflects the man in every page. Even the footnotes are instinct with character and originality. Mendeléeff's "Principles" may be said to stand in the same relation to the chemistry of the latter half of the nineteenth century that Dalton's "New System" did to the chemistry of the earlier half. Each work was the definite and orderly presentation of the doctrine and philosophy of its author.

There is hardly a department of chemistry in which Mendeléeff did not labour, at one time or other, during the thirty years of his activity as a teacher. Chemical mineralogy, chemical geology, and the chemistry of aliphatic substances in turn, and apparently with equal zeal, attracted his attention. It is to this catholicity and power of taking broad and comprehensive views of the operations of chemistry that Mendeléeff owes his eminence as a chemical philosopher. But it is in the domain of physical chemistry that his fame as a worker chiefly rests. His early papers on the thermal expansions of liquids above their boiling points up to temperatures at which their cohesion and latent heats are *nil*, and at which the liquid becomes gaseous independently of pressure and volume, anticipated the researches of Andrews, and were, in their turn, a development of the observations of Cagniard de la Tour, Wolff and Drion.

The same faculty of perceiving the underlying basis of a physical generalisation is seen in the notable paper which he communicated to our Chemical Society in the year following his election into that body as an honorary foreign member, in which he developed a general expression for the expansion of liquids under constant pressure, analogous to that which expresses Dalton's law of the uniformity of expansion of gases. The formula $V = v + kt$ applies only to a so-called ideal gas; in like manner, Mendeléeff's expression is to be regarded only as a first approximation—that is, as applicable only to ideal liquids. In the case of actual liquids the deviations from the ideal form increase not only as the liquid approaches the point of change of state of aggregation, but also augment with diminishing density, increasing cohesion, and diminishing molecular weight, just as Mendeléeff himself showed that the deviations from Dalton's law were related to the molecular weights of the gases. Subsequent observers, by applying van der Waals's theory of the relation between pressure, volume, and temperature, have shown that the development of Mendeléeff's formula affords a simple and ready method of calculating the critical temperature of bodies from their thermal expansions as liquids—in other words, of reaching the same constant by a method analogous to that employed by Mendeléeff himself to the observations of Kopp and Pierre.

Mendeléeff's work on the relative densities of aqueous solutions of alcohol takes its place as a classic alongside the works of Blagden and Gilpin, and of Drinkwater and Fownes in this country, and, as in the case of these observations, has been utilised by Continental Governments for the purposes of revenue. These determinations were applied by Mendeléeff to the elucidation of a theory of solution, and in a paper, also communicated to our Chemical Society, he sought by means of them to reconcile Dalton's doctrine of the atomic constitution of matter with modern views re-

specting dissociation and the dynamical equilibrium of molecules. How far this attempt will be ultimately successful time alone can show. Mendeléeff had little sympathy with the theory of electrolytic dissociation, which, he declared, was not in harmony with the facts of observation, and was of little use in facilitating our comprehension of the true nature of solution. Nor was he more predisposed towards the conception of electrons, although perhaps his belief in the integrity of the atom was hardly so fundamental as that of Dalton, who would have gone to the stake rather than recant his declaration: "Thou canst not split an atom!"

The story of the rise and development of the Periodic Law is so well known that it is unnecessary now to dwell upon it. By a good fortune, which some may regard as evidence of predestination, Mendeléeff lived to see the verification of his predictions in the discovery, in rapid succession, of gallium, scandium, and germanium; and no seer ever prophesied more truthfully. It was the astonishing accuracy of Mendeléeff's prognostications, and the apparent boldness and confidence with which they had been uttered, that profoundly impressed the whole scientific world, and secured for his generalisation a respect and acceptance for which otherwise it would have had long to wait. This generalisation is now woven into the fabric of modern chemistry, and is universally accepted as the only rational basis of classification. Like many other great natural truths, we are able, on looking back, to discern its germs in the tentative efforts of previous thinkers who more or less dimly appreciated the significance of the facts upon which it is based, but it is perfectly certain that Mendeléeff knew nothing of the prior work of De Chancourtois and of Newlands, and was no more influenced by it than was Dalton by Richter or by the "Comparative View of the Phlogistic and Antiphlogistic Theories" of William Higgins. In the memorable Faraday lecture which he gave to the Chemical Society in 1889, Mendeléeff, with a true nobility of mind and a modesty which revealed the real greatness of the man, gave adequate expression to his appreciation of the efforts of his predecessors, claiming for himself only courage and intrepidity in placing "the whole question at such a height that its reflection on the facts could be clearly seen."

The Periodic Law has so far stood the test of experience, and each new extension of the science is consistent with its provisions. The inert gases of the atmosphere find their place in the system, and the only radioactive substance the chemical properties of which have been sufficiently investigated has an appropriate position among its correlated elements. In the old days the followers of Stahl sought to make the conception of phlogiston an all-embracing doctrine. Mendeléeff anticipated these attempts as regards his own generalisation by showing that even the universal ether may be included within his system. In his last paper, published in 1902, entitled "An Attempt towards a Chemical Conception of the Ether," he starts with the assumption that the ether possesses mass, and that it has an atomic weight many times less than that of hydrogen, something of the order of 10^{-6} when $H=1$; that it is monatomic like argon and helium, and that by its small density and extremely rapid motion it permeates all matter and space. The ether thus becomes, not an affection of matter, but a distinct entity capable of being attracted by elements in proportion to the weights of their atoms, and he held that the phenomena of radio-activity could be explained by the gradual emission of this ether from such substances as uranium and thorium which have the highest atomic weights of the elements.

The truth embodied in the Periodic Law has led many to suppose that this generalisation lends sup-

port to, and is indeed the proof of, the validity of the assumption of a primordial matter. Mendeléeff himself declined to see that such an inference was warranted. He saw nothing in the law inconsistent with the idea of the individuality of the elements, holding that until it could be definitely shown that one element could be transformed into another, or that ether and matter were mutually convertible, the elements must be regarded as distinct and separate entities, immutable and unchangeable.

Mendeléeff not unfrequently visited this country, and was personally known to many British chemists, to whom he was always welcome. His tall and commanding presence, his fine head, with its tangle of long, wispy white hair, his expressive features, his guttural utterance, the wisdom and originality of his talk, his shrewdness and sense of fun, all stamped him as an uncommon and strong personality, which immediately made its presence felt in any company in spite of the innate modesty of the man. Of wide liberal views, intensely national, and a great power in the University, Mendeléeff was doubtless a thorn in the side of bureaucratic Russia, and it was currently reported that the frequent foreign missions on which he was sent were so many covert attempts to keep him at arm's-length.

Every scientific honour that this country could pay was awarded to him, and he was profoundly touched and deeply grateful for the sympathy and appreciation thus extended to him. On the occasion of his delivering the Faraday lecture it fell to the writer's duty, as treasurer of the Chemical Society, to hand him the honorarium which the regulations of the society prescribe, in a small silken purse worked in the Russian national colours. He was pleased with the purse, especially when he learned that it was the handiwork of a lady among his audience, and declared that he would ever afterwards use it, but he tumbled the sovereigns out on the table, declaring that nothing would induce him to accept money from a society which had paid him the high compliment of inviting him to do honour to the memory of Faraday in a place made sacred by his labours.

T. E. THORPE.

PROF. ANTONINO MASCARI.

BY the death of Prof. Antonino Mascari on October 18, 1906, solar physicists throughout the world, and more particularly those who were his intimates in the Italian observatories, have sustained a severe loss.

Born at Campobello di Mazara (Sicily) on December 4, 1862, Mascari proceeded in due course to the University of Palermo, where he took the engineering course and obtained his degree in that faculty in 1887. It was while there that he developed the predilection for astronomical investigations, and, under the guidance of Prof. Riccò, worked with that activity and intelligent ability which were the outstanding features of his whole career. He was later appointed to the position of assistant to the Piazzi Foundation, and thus was fortunate enough to be able to continue his association with Prof. Riccò—an association which has proved of inestimable benefit to the study of solar physics.

In 1892 Mascari was appointed first assistant at the Observatory of Catania, where the solar prominence observations, commenced by Tacchini at Palermo in 1872, were continued. Probably only those who have had to use these Italian observations in discussions of collateral phenomena are aware how well this task was performed, and how much the science of solar physics owes to the indefatigable labours